

A Compact Meteorological, Water Following (MET) Drifter for Aircraft Deployment, Wind Forcing of East Sea Currents

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LONG TERM GOALS

The long-term goal is to study the variability of the upper ocean current systems and their relationship to meteorological forcing. To this end, spatially coherent field observations are required of the ocean response and the atmospheric forcing. A new instrument, the MINIMET, a water-following drifter, was designed as a tool to obtain ocean and atmospheric data. Arrays of MINIMETs will be utilized in a coordinated field experiment in marginal seas to study wind-driven ocean currents.

OBJECTIVES

The scientific objectives are to obtain direct measurements of ocean circulation on various time and space scales that are of sufficient spatial density and time duration so both seasonal means and intra-seasonal variations can be determined. This data will be used to test model dynamics, both in the processes which determine the mean motions, as well as the exchange of energy and momentum between the mean and eddies.

APPROACH

In marginal seas, circulation patterns are spatially complex and seasonally variable. Lagrangian techniques are well suited for developing quantitative estimates of the circulation in the areas where the general pattern of currents are not well known. Wind fields are complex, often affected by mountains or other land boundaries. Large numbers of low-cost drifters are released from volunteer ships (East Sea) or from small, fixed wing aircraft (Gulf of Mexico) to map the circulation patterns. A new, instrumented drifter, the MINIMET, was developed by ONR and NASA support, to retrieve data on wind-speed,

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wind direction, SST, sea-level pressure and mixed layer current. With the cooperation and support of Prof. John Lee of the Pusan National University, Korea, and the NASA/QuikScat Cal-Val Team, 60 MINIMETs will be released in the East Sea in the 1999-2000 period. Additionally, 36 SVP drifters will be released in the Korean Warm Current by the Fisheries Research Institute. This study is part of the ONR supported Japan-East Sea project.

WORK COMPLETED

The MINIMET drifter design is complete and sea trials show its ability to retrieve usable wind-speed and wind directions by the WOTAN methodology. Preliminary data sets from the Labrador Sea (23 drifters out of 32 provided data) and the California Current (all 5 provided data) have been retrieved. A research paper has been written on the circulation and eddy field of the East Sea and submitted to the Journal of Physical Oceanography. A second manuscript on the Labrador Sea measurements is in progress (with R. Milliff and W. Large at NCAR). As of November 1998, 15 MOD-III MINIMETs are constructed and 20 are in various stages of completion.

RESULTS

The result of the historical drifter analysis shows that there is a significant decrease of eddy energy across the polar front in the East Sea. Strong, mean flow exists almost everywhere throughout the warm water layer, rather than being confined to boundary currents. Eddy energy conversion to and from the mean is computed by Lagrangian techniques of analyzing the eddy energy budget. The figure below is from the research paper, "Energetics of the Surface Circulation of the Japan/East Sea" which is referenced below.

IMPACT/APPLICATIONS

The methodology of using large arrays of low-cost drifters to study the ocean has produced the first ever ocean basin scale maps of accurate upper layer circulation.

TRANSITIONS

The MINIMET drifter is now available on a commercial basis. It represents a new development in the use of low-cost drifters to return a suite of data from the remote ocean. The National Weather Service and the French Met Service are already using these drifters for operational systems. NAVOCEANO will begin to acquire and deploy SVP-B drifters this year, which is identical to the MINIMET except for wind measuring capability.

RELATED PROJECTS

The closest related project is the Global Drifter Program of NOAA. Data from the East Sea project will be deposited and analyzed at the Global Drifter Center at AOML and the East Sea project will receive all of the drifters data from the North Pacific.

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The MINIMET drifter development has been completed with the construction of MOD-III devices. Components of these are now made commercially, with the development of a small and low-cost, digital WOTAN system. By systematic comparisons with research ship measurements of winds, it has been found that each hydrophone on the WOTAN unit has to be calibrated insitu.

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